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Simple Proof of a Fundamental Theorem in the Theory of Functions.

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“If a Riemann’s Surface is reduced by m cross-cuts into n distinct simply connected pieces, and by m' cross-cuts into n' such pieces, then $m - n = m' - n'$.”

(a) In a simply connected surface, one cross-cut makes two simply connected pieces, and n cross-cuts make $n + 1$ such pieces.

(b) In a p -ply connected surface, $p - 1$ *appropriate* cross-cuts *are necessary* to reduce it to a simply connected surface.

(c) If a p -ply connected surface has been reduced by m cross-cuts to n simply connected pieces, the $p - 1$ cross-cuts noted in (b) have been made. Thus the n simply connected pieces are due to $m - (p - 1)$ of the cuts. Thus by (a),

$$\begin{aligned} n &= m - (p - 1) + 1 \\ \therefore m - n &= p - 2, \text{ a constant for any given surface.} \end{aligned}$$

Harkness and Morley, p. 229, and Forsyth, p. 317, give Neumann’s proof. Riemann’s proof will be found in his *Gesammelte Werke*, pp. 10, 11; also in Durège’s *Elemente der Theorie der Functionen*, pp. 183–190. For Lippich’s proof see Durège, pp. 190–197.